S
371.33
A3ir
1990

LCI LAMBDA COMMUNICATIONS INC.
30 Hackamore Lane, Suite 1 • Bell Canyon, California 91307

SECOND INTERIM REPORT
FOR
THE MONTANA EDUCATIONAL TELECOMMUNICATIONS PROJECT

MONTANA STATE LIBRARY
3 0864 1002 0322 6

LCI LAMBDA COMMUNICATIONS INC.

SECOND INTERIM REPORT FOR THE MONTANA EDUCATIONAL TELECOMMUNICATIONS PROJECT

Prepared for:

State of Montana
Mr. John Aubry
Department of Administration
Telecommunications Bureau
Mitchell Building - Room 219
Helena, Montana 59620

STATE DOCUMENTS COLLECTION

MAY 23 2003

MONTANA STATE LIBRARY
1515 E. 6TH AVE
HELENA, MONTANA 59620

Prepared by:

Lambda Communications Inc.
30 Hackamore Lane - Suite #1
Bell Canyon, California 91307

Telephone (818) 702-9466
FAX (818) 702-9577

April 26, 1990

Digitized by the Internet Archive
in 2012 with funding from
Montana State Library

http://archive.org/details/secondinterimrep1990mont

Table of Contents

SECTION 1 - EXECUTIVE SUMMARY ---------- 1
1.1 Needs Assessment Update 1
1.2 Preliminary Conclusions 2

SECTION 2 - SECOND INTERIM REPORT REQUIREMENTS ---------- 4
2.1 Educational Resource Sharing 4
2.1.1 Applications of Telecommunications 4
2.1.1.1 ITFS 4
2.1.1.2 Broadcast Television ("PBS") 6
2.1.1.3 Radio 8
2.1.1.4 Computers 8
2.1.1.5 Video Disc 9
2.1.1.6 Cable Television 9
2.1.1.7 Satellite 10
2.1.1.8 Compressed/Digital Video 10
2.1.1.9 Other Technologies 11
2.1.2 Telecommunications Planning 11
2.1.2.1 In-service Training 12
2.1.2.2 Centralized Information Source 12
2.1.2.3 Funding 13
2.1.3 Cooperative Programming 14
2.1.3.1 PBS Model 14
2.1.3.2 State Cooperative Model 15
2.1.3.3 State Agency Model 16
2.1.3.4 Consortial Model 17
2.1.4 Resource Sharing 17
2.1.4.1 Human Resources 18
2.1.4.2 Production Facilities 18
2.1.4.3 Programming/Courseware 18
2.1.4.4 Staff Development 19
2.1.4.5 Cooperative Purchasing 19
2.1.4.6 Facilities Shared 19
2.1.5 Recommendations 20
2.2 Proposed Organizational & Administrative Structure 22
2.2.1 Principles of Organizational Planning 22
2.2.2 Recommendation 22
2.2.2.1 Organizational Approach 23
2.2.2.2 Consideration of Cooperative Issues 24
2.2.2.3 Suggested Cooperative Model 24
2.2.2.4 Governance 25
2.2.2.5 Staffing 26
2.2.2.6 Funding 26
2.2.2.7 Program Library 27
2.2.2.8 Technical Support/Transmission Facilities 27
2.2.2.9 Economic Development 27
2.3 Montana Educational Origination Options 28
2.3.1 Present Origination Capability 28
2.3.1.1 Through the MSU Uplink 28

2.3.1.2 Through Computers 29
2.3.1.3 Through Microwave 30
2.3.1.4 Through Compressed Video 30
2.3.1.5 Through Fiber 32
2.3.1.6 Through Broadcast Television 33
2.3.1.7 Through RTS Stations 33
2.3.2 Further Investments 34
2.3.2.1 Additional C band Uplink 34
2.3.2.2 Additional Downlinks 35
2.3.2.3 Additional Modems 35
2.3.2.4 New Regional Networks - Fiber Optic 35
2.3.2.5 Compressed Video Network - Terrestrial 36
2.3.2.6 Enhanced State Telephone System 37
2.3.2.7 Studio/Classroom Equipment 38
2.3.2.8 Training 38
2.4 End User Equipment Requirements 39
2.4.1 Minimal Receive Site Configuration (Computer Interactive Service) 39
2.4.1.1 Minimum Equipment Configuration for Computer Interactive Service 39
2.4.1.2 Desirable Equipment Configuration for Computer Interactive Service 40
2.4.2 Desired Receive Site Configuration (For Satellite Delivered One-Way Video Service) 40
2.4.2.1 Minimum Equipment Configuration for One-Way Satellite Delivered Service. 40
2.4.2.2 Desirable Equipment Configuration for One-Way Satellite Delivered Service 40
2.4.3 For Terrestrial Delivery of One-Way NTSC Video and Audio 41
2.4.4 For Satellite Delivery of Full Bandwidth One-Way Video and Two-Way Audio. 42
2.4.5 For Terrestrial Delivery of Full Bandwidth One-Way Video and Two-Way Audio 42
2.4.6 For Digital (Compressed) Two-Way Video and Two-Way Audio 42
2.4.6.1 Codec Costs: 43
2.4.6.2 Camera, Monitor and Controls 43
2.4.6.3 Physical Facilities 44

SECTION 3 - NEEDS ASSESSMENT ----------- 45
3.1 Proposed Organizational Chart 46
3.2 Programmatical Needs Identified By Assessment 48
3.2.1 K-12 Needs Identified 48
3.2.2 Middle School Needs Identified 49
3.2.3 High School Needs Identified 49
3.2.4 College/University/Voc Tech/Tribal Needs Identified 49
3.2.5 Organizational Structure Comments 50
3.2.6 Reported System's Needs & Futures List 51
3.3 Other Cooperative Programming Issues 52

SECTION 4 - ATTACHMENTS (AVAILABLE UPON REQUEST) --------- 58

SECTION 1 - EXECUTIVE SUMMARY

The second interim report in the Montana Educational Telecommunications Project requires the consulting team to evaluate and make recommendations in the following four subject areas:

1. Educational Resource Sharing

   Section 4.1.4
   Provide recommendations on support for improved shared action through telecommunications, such as resource sharing among school districts; interaction among college and university campuses; home and workplace delivery of courses.

2. Proposed Organizational & Administrative Structure

   Section 4.1.5
   Identify alternative organizational and administrative structures, with recommendations.

3. Montana Educational Origination Options

   Section 4.1.6
   Evaluate and make recommendations on telecommunications technology origination options in support of education, noting what is in place and what further investments may be needed. Address specifically the uplink accepted for installation at Montana State University.

4. End User Equipment Requirements

   Section 4.1.7
   Identify <u>minimal</u> required receive site configurations and <u>desired</u> receive site configurations, with estimated costs, for equipping school buildings and classrooms (or libraries or other public buildings) to accommodate recommended educational telecommunications.

Section 2 of this report addresses each of these four issues in detail.

1.1 Needs Assessment Update

As part of the HB28 project to assess and design elements of an educational telecommunications network, we have been surveying and meeting with a cross section of the educational community as well as others who have training and re-licensure/re-certification needs.

To date surveys have been sent to all public school facilities in the state and to all universities, community colleges, technical centers, tribal colleges, libraries and several state agencies.

As of this report we have received responses as follows:

Total Distributed	975
Elementary Schools	207
Middle/Jr. High Schools	11
High Schools	44
College level institutions	48
Total Responses (Percentage)	32%

The nature of responses parallel each other to such an extent that we can set out with confidence certain network requisites and programmatical needs for the various segments in the state. In addition to the educational institutions, we have received a response from the Corrections Division of the State of Montana, five public libraries and from OPI. The project team has also met with in excess of five-hundred-fifty individuals to date in approximately ninety interviews which reviewed needs, future plans as they might be related to an educational network and issues relating to the project concept. Section 3 of this report details the programmatical and organizational comments received in the continuing Needs Assessment portion of the project.

1.2 Preliminary Conclusions

The actual technical structure of the network notwithstanding, there are a set of preliminary conclusions which seem to remain constant as we move forward with the project:

1. The availability of existing and very adequate telecommunications resources within the state of Montana suggests that any educational network be first configured utilizing those resources rather than the development of a new telecommunications system.
2. The stated present educational needs can be satisfied through the application and coordination of existing Montana based telecommunications resources identified in this project.
3. The projected future needs of the Montana educators can be met through the natural evolution of one or more of the technologies proposed to be applied to the solution of the present educational problems.

4. The demonstrated ability of the Telecommunications Bureau of the Department of Administration to manage complex telecommunications networks is critical to the long term success of any proposed educational network. The Telecommunications Bureau should be responsible for the day-to-day operations of any educational network with the additional requirement of coordinating the dissemination of statewide telecommunications resources available for educators.

5. The Office of Public Instruction should play a key role in the coordination of the dissemination of any available educational telecommunications courseware resources for the state of Montana. One such media for this purpose would be a state supported data base kept constantly updated by OPI and accessible by any personal computer.

6. No statewide educational telecommunications network will be possible in the state of Montana without the active support of private sector business together with the local support at the school level.

7. The resulting multi-technology educational network will take the form of a coordinated application of existing telecommunications resources throughout the state.

8. The implementation of the network will be over a two to three year period.

9. The long term success of the project will be based entirely upon the issue of "affordability" at the local school level. Although critically important, as well, the initial capital costs of construction pale in comparison with the relative importance of the day-to-day incremental operating costs of the network. Regardless of the level of technical sophistication, no technical solution for a Montana Educational Network will be used at the school level if it is not affordable on a day-to-day basis.

10. No one single technological solution can possibly satisfy the widely diverse requirements resulting from the Needs Assessment.

SECTION 2 - SECOND INTERIM REPORT REQUIREMENTS

2.1 Educational Resource Sharing

Section 4.1.4
Provide recommendations on support for improved shared action through telecommunications, such as resource sharing among school districts; interaction among college and university campuses; home and workplace delivery of courses.

2.1.1 Applications of Telecommunications

Given (1) the almost universal responses from the Needs Assessment regarding telecommunications technology questions and (2) the consideration of "... improved shared action through telecommunications ..." requirement of this contract, it seems appropriate list some of the most common uses of technology in the educational community as a whole. The intent is to focus on the programmatical uses rather than emphasize the technical aspects of the medium.

2.1.1.1 ITFS

ITFS (Instructional Television Fixed Service) has been the point of some controversy in the past few years. Originally reserved for education, the cluster of channels became the point of controversy when MMDS (Multichannel Multipoint Distribution System - normally referred to as "wireless cable systems") operators asked the FCC to open up the channels for commercial use. A compromise was reached about three years ago when the FCC agreed to make those channels in the E and F groups not already used available for commercial use. In addition, the FCC also now allows educational agencies to sub-lease excess time to the MMDS operators. There are, however, criteria established by the FCC for those institutions doing this, which protect the integrity of the channels. "MMDS operators" are those who distribute a limited number of television signals to homes and other locations throughout a designated service area via microwave on a monthly fee basis similar to cable television service.

ITFS is essentially a point to multi-point medium; those involved in such a system must have transmission antenna (for those transmitting the signal) and a receive antenna (student site locations). Many campuses use the technology to deliver to distant sites and at the same time transmit through local cable systems, thus, in certain cases delivering "live" classes into homes. In the case of cable and delivery to the home it is harder to have the students feel they are part of a class, but several techniques are utilized to minimize this problem.

For educators, the availability of these channels has allowed institutions to transmit instructional programming to distant sites within service areas to those unable to reach a given campus location. The channel capacity has also allowed institutions to develop contract arrangements with a variety of entities who desire special on-site training for their employees, paying the costs so that such programs are almost always cost covering. As schools become more sophisticated in such programming they quite often make money which helps defray costs for equipment upgrades and the broadening of program offerings.

Typically, an ITFS system consists of an "electronic classroom" at a campus from which the classes are distributed. The classrooms vary depending on the nature of design and availability of money. The rooms are arranged like most regular classrooms with an instructional station and seats for students.

The "electronic" element consists of the cameras and the microphones needed to distribute the class to distant locations. The camera(s) are located at the rear of the room in order to follow the instructor, and, when there is more than one camera available, to also pick up the responses of the students taking the class, on-site, in the room with the instructor. Sometimes there will be a camera to the front of the room in order to catch the expressions of students during lecture. Some institutions hang the cameras from the walls; most control them remotely from a central control. Almost always there is a camera over the instructional area in order to pick up print work the instructor wishes all students to see or which enables the instructor to write, draw, etc. in lieu of the more traditional blackboard. The blackboard, however, is still preferred by some instructors and it will be found in many of these classrooms as an important instructional tool.

The main element from an instructional standpoint in these rooms is the usual "talk-back" capability. Microphones either on the walls or on desk tops, allow student responses to be heard clearly by those attending at a distance. A loudspeaker system in the room allows students present, and the instructor, to hear comments from distant locations. Monitors on the walls or small sets placed strategically on desk tops allow those present to see what is going out from the room to the distant sites. The instructor will commonly have a monitor at the teach-

ing station allowing the outgoing signal to be seen without the instructor having to move away from the front of the room to check what is being transmitted.

The cameras are most often operated remotely by students from an adjacent control room. The more exotic configurations utilize character generators for graphics capability, and some have film-chain equipment allowing for the playing of film and video in much the same way a television station plays pre-recorded material.

The most desirable aspect of this kind of system is that it is:

1. Interactive, with students, instructor and distant learners all able to talk back and forth, live during a class session;
2. The live video permits the instructor to change, if change is needed, on the spot in order to respond to students' questions.
3. The live element allows those away from the campus to have a sense of belonging to the main campus and having a way to interface with the instructor without having to travel to the campus.

2.1.1.2 Broadcast Television ("PBS")
Almost from the time television first started to enter the home, educators have used the medium to extend instructional programs through the use of the medium.

It is currently estimated that eighty percent of the nation's postsecondary educational institutions are using television to distribute instructional programs into the home.

There is no rule of thumb when selecting a station for this purpose. Public Broadcasting, for example, offers its own Adult Learning Service which programs a number of courses each semester, many of which can be seen over their stations or which can be obtained on tape and distributed through closed systems on campus or over cable.

Private broadcasters in several areas throughout the nation still donate "free" air-time to institutions as part of their required "public service time" as required by the FCC. Private stations are also willing, as is Public Broadcasting, to have an institution pay for such

time. On average, however, one will find that the Public Broadcasters charge for such use and the private sector stations give the time free.

The format for such programming has, through the last decade especially, become fairly traditional in its own right. This is largely due to trial and error plus some good design work along the way.

The typical pre-recorded class, done for national distribution, is formatted as follows:

1. The subject matter is determined through some form of survey among instructors in the field;

2. Development is done by both subject matter experts taken from institutions and by production staff and can take as long as three years to finish;

3. The production budget, which sometimes hovers between a million and two million (but can be much cheaper), is usually underwritten by a grant (i.e. The Annenberg Grants) or by a corporate entity(s). Educational institutions rarely underwrite such courses because of their cost, although a well produced class is a good source of income for the producers;

4. Support materials most often include:

   * A text which corresponds to the video lesson by lesson;

   * A faculty manual which walks the instructor through each lesson, quite often suggesting other activities and materials students can use. They most often also have a test bank from which the local instructor can build quizes, mid-terms and finals. Usually it is suggested that the local instructor build his/her tests incorporating questions based on instructor based input at the local campus;

   * A student handbook designed to support the text and the video input.

   * The local institution assigns a resident instructor who is available, by phone, at predetermined hours and who conducts sessions, on/off campus, for enrolled students. Tests are usually administered live at the campus or proctored at a pre-determined site.

* Tests, assignments and other course requisites are normally the same as those found in a regular class.

2.1.1.3 Radio

Courses offered over radio are not used as frequently as their video counterparts. They are, however, very effective if designed properly. They are useful in situations where potential students don't have access to television sets. For example, commuters in metropolitan centers who have inordinate travel time have found such classes of use.

The courses are normally lecture in format, and, depending on the availability of time on the station, can be interactive in the same manner the ITFS classes are, having students call in live, to the instructor, establishing interaction and giving the class spontaneity.

Support materials are normally the same as those found in the video class, with more emphasis placed on providing graphic illustrations as needed.

2.1.1.4 Computers

Computer-aided-instruction (CAI) is a popular concept currently being discussed and sometimes used in the educational community. Personal computers have been purchased, more often than not, by institutions without having determined how they will be incorporated into instruction. Namely, the lack of availability of software has more often than not ended up relegating the unit to a closet. When properly utilized, the personal computer or the terminal tied to a mini or main frame can be of great instructional significance. The most obvious strength of the computer is the ability for the student to interface with the software in a one on one interactive basis.

Because of the ability of the computer to utilize telephone lines for interconnection, the campus can become an interactive base for students at a distance who have access to an appropriate computer.

More importantly, with the growing availability of technology which can digitalize voice and video economically, the computer merged with video and voice can be utilized as the "best yet" system for distant learners.

Courses designed for computer work have text/graphic capability as a base. Hence, reading skills become important when planning for student success. Such courses are often found to have other components, i.e. audio tapes which can help students, as well as the text and other print materials.

The growing amount of resources through data bases and resource sharing by using bulletin boards and electronic mail make the computer the fastest growing element in the family of technologies available to the educational community.

2.1.1.5 Video Disc

The video disc is a new entry into the field of educational technology. Although not widely available on campuses or in the home as yet, the disc is rapidly being discussed as another viable option for distant learners. What makes this technology interesting is the potential of using the great storage resources of the technology as a learning tool. The video disc can store thousands of images which can be retrieved in seconds and displayed in either still or motion format and with audio.

Using this technology in an educational setting gives the developer of curriculum a chance to design information "branches" which can automatically be given to a student based on how that student responds to questions. If, for example, a student responds to a question incorrectly, they can be sent back to retrace the information already covered. If the student doesn't answer the question, the tracking can take another "branch" to reinforce the correct answer.

There are many who look to a combination of the disc and the personal computer using a home video screen as an ideal situation if live interaction is not available.

2.1.1.6 Cable Television

Because cable systems are "hardwire" systems, they can accomplish a combination of several of the elements for teaching at a distance which we have already discussed.

Much depends on the way a system has been constructed and, most importantly, whether it is capable of two-way interaction. This technology allows for such activity, but, more often than not, the cable owner cannot afford the luxury of such a system.

More and more educational institutions are striking up a relationship with cable systems, negotiating a local "educational" channel which allows them to program classes in the best possible setting (unrestricted by broadcast time constraints) and with the potential for students to interface via telephone line "live", or by computer. Cable systems can also have an addressable capability allowing for a single student to access data as an individual. This potential, coupled with some of the other techniques we have already discussed, could lead to the development of some very sophisticated courseware that could be reached through cable for those unable to reach a campus.

2.1.1.7 Satellite

Delivery by satellite probably has as good a potential as any of the technologies discussed. It is capable of carrying voice, video and data or a combination of all of the above. The major constraint is that it is basically a one-way technology for instruction unless coupled with the telephone or two-way radio. In order to become a two-way system, satellites require a transmitting antenna at each end in exactly the same way television, radio and ITFS do. Those systems not having a "hard wire", i.e. cable and the telephone, as a result usually merge the technologies in order to have the interaction normally preferred.

However, for the telecourse activity we have already outlined using both live or prerecorded material, the satellite has the greatest potential for delivery of materials to large geographic areas. The ability of the satellite to be received over full continents to learning sites makes its potential for education very exciting. Delivery of special courseware to distant locations over hundreds of miles is easily handled by satellite technology. Receive dish cost is on a downward spiral making even home delivery of signal within the realm of possibility for many.

The use of such technology to bring together a variety of groups at great distances is being demonstrated every day through teleconference activity.

2.1.1.8 Compressed/Digital Video

An emerging technology using digitalized/compressed video has attracted the attention of the educational community since 1987. The use of video utilizing these formats enables institutions to reach distant sites through conventional telephone lines. By using Codec technology,

schools can effectively utilize live two-way video as an instructional tool making classes, as taught in the classroom, available to any area which has telephone/data linkaging.

Through the use of fiber and T-1 technology, Codec's are being looked at as a viable alternative to having an uplink or two-way terrestrial (microwave or ITFS) system.

Cost is currently the most prohibitive element when considering this kind of technology. Time use billing of telephone lines and lower costs for Codec units are considered necessary by most institutions looking to the use of two-way interactive video through this medium.

There are an emerging number of institutions in the country, however, who are already utilizing Codec transmission to reach students located at a distance. The emerging use of the technology is to locate a camera(s) and microphone(s) at a campus and a remote site. Live classes on a campus can then be transmitted with participants at both locations able to see and talk to each other. It is possible to also connect multiple sites to an initiating campus using this technology.

2.1.1.9 Other Technologies

There are a variety of other technologies being used in the delivery of instruction to distant learners throughout the world. Too many to linger on for purposes of this report. It is important to note though, that as each school year begins, there are more and more institutions utilizing one or more of these systems in an effort to be more flexible, cost effective and responsive to the needs of their students.

Other systems have been or are being used to a limited degree such as videotex, teletext, slow-scan television, sub-carrier frequency use, vertical blanking interval use in video and laser technology as well.

2.1.2 Telecommunications Planning

School systems K-12 through university need demonstrations of how long term planning might be accomplished in relation to new and emerging technology. A framework for such planning might look like this:

* Goal clarification
  - Bench marks of success
  - Scenarios
  - Underlying assumptions
  - Resources
* Identification and development of strategies
* Evaluation

School districts and post-secondary institutions must learn how to manage converging academic technologies. Because there are seldom telecommunications planning efforts, many schools have fallen into the trap of purchasing equipment and software which do not adapt to an educational environment. Instructional staff must have the technical knowledge and skill to operate hardware. The integration of new technologies into the educational setting will occur when educators master the skills to utilize that technology. When that occurs, instructional staff will embrace their newly acquired skills and really start to use the new options available to them.

The assessment of Montana's needs in regard to this project and its mandate from HB28 have produced three important issues which must be addressed in any review of potential organizational and administrative considerations. They are:

2.1.2.1 In-service Training

There is no substantive in-service program at any level of public or private education in Montana which has provided an understanding of what role technology can play (by medium) in the delivery of instruction and support services. It is clear, especially within the primary focus group (K-12), that staff is unclear about options and how they might satisfy certain needs.

If teachers don't know the advantages and disadvantages of certain elements of telecommunications, i.e. satellite delivered programs, they cannot make appropriate judgments in regard to setting priorities and selecting programs.

In higher education, the level of awareness is more sophisticated, but there is still a lack of coordinated effort and in-service training.

2.1.2.2 Centralized Information Source

There does not seem to be a collective awareness of available programs nor any attempt to coordinate at a

regional or state level to access those programs through cooperative purchasing or leasing using the concept of greater purchasing power by joining forces.

There is limited distribution of courses through telecommunications delivery. This activity is largely local in nature although the universities have made some effort in this regard to distribute programs to distant locations. The university effort, however, is constrained to individual campus programming and does not appear to be consortially motivated.

OPI does not appear to have in place a system wherein instructors can access information in regard to systems and programs available to individual schools or districts. There is no coordinated effort at the state level because of limited staff and resources.

There are limited production facilities in the state. At the K-12 level they are virtually nonexistent. This means that distribution of Montana generated instruction or support programming will have to focus on just a few institutions. Those schools, such as Montana State University and the University of Montana, have other uses for those facilities as part of their institutional mission.

2.1.2.3 Funding

It is clear that Montana has several issues which overlap, in regard to economic constraints, that could have an impact on the development of an educational network for the state.

On the negative side, telecommunications activity can often be very expensive. The very nature of developing resources for distribution on an ongoing basis can be expensive as well and requires a commitment, long term, to provide staff and resources, especially if the state is going to generate programs by Montana educators for their own schools. In-service training, as mentioned before, is mandatory in order for staff to be trained for such activity, let alone making them aware of different technology mediums that might be available. There are several illustrations of this problem that we can cite.

On the positive side, there is great interest in networking by the educational community. By having an educational network, Montana can address the "Equity" issue in the state by providing access to certain programs, regardless of location. The network can broaden the curriculum and extend special resources, available in a limited way now, to the whole state.

Experience in other states has shown that the private sector is willing and interested in helping in a variety of ways with such a system because of its direct relationship to economic development. For a state such as Montana which is looking to the private sector in regard to strengthening its economic development, an educational network should present several options which can be widely supported.

2.1.3 Cooperative Programming

Schools and colleges outside Montana have been developing cooperative working relationships in an increasing number for the past decade. The need for sharing has been made more evident by the increased demand for more data in all forms and the downward trend of school financing. The increase of useable technologies have helped to offset this problem, but only in a minimal way.

For educators, the solution to on-line costs and television/satellite uplink and transponder costs has been to group together in a variety of patterns which are normally reflective of the region and state where the cooperative is functioning. We have attempted to give some detail in regard to funding and support in what follows and will review some options we think should be considered by Montana later in this report.

Some examples of cooperative organizations are:

2.1.3.1 PBS Model

In this model, the Public Broadcast entity in a region or a state is used as the operational and administrative base for a cooperative. Curriculum for all levels is identified through a variety of processes, normally through segmental working committees who identify program needs. The PBS entity makes time available on its channel and either offers that capacity free to the members or charges an hourly rate to recoup its operational costs. Membership is voluntary and, other than a membership fee, participants can most often pick and choose programming which fits available funding. Administrative cost is maintained through a membership fee.

The addition of microwave and/or ITFS sometimes augments the open broadcast and is used to send programming directly to educational facilities. The use of ITFS and microwave also allows for more flexibility in regard to original programming because it is delivered on-site rather than through open broadcast or cable and provides

the potential for interactive programs. One way-video and two-way audio is the most frequent mode of use as opposed to two-way video/two-way audio.

2.1.3.2 State Cooperative Model
This model uses a cooperative of interested parties through shared involvement. In Utah we understand the cooperative is largely one of sharing operational duties which then reduces the need for staff and production capability because every unit involved takes care of its own need, using the Cooperative for transmission purposes only. Agencies in this model are usually K-12, Community College, University and various other partners such as state government and certain not-for-profits. In most instances one member entity coordinates the distribution of programs.

Operations are handled by committee and the Board has elected officers who handle the details of administering the activities of the organization. Support can come from state funds obtained through legislation, existing staff and budget, membership fees, or a combination of all of the above.

In Oregon, the state has established an organization called "Oregon Ed-Net." Oregon Ed-Net has its own independent Board and advisory committee structure. The Board has been appointed by the Governor and the initial support for up-front costs has been provided by the state legislature. Oregon Ed-Net is funded with $8.5 million dollars for both the construction and start-up costs for the network. A small staff is in the process of being formed and within the next few weeks an Executive Director will be named to start bringing together the organization.

The Oregon Ed-Net staff, which is designed to be administrative in nature and minimal, will draw upon Oregon Public Broadcasting and member organizations to provide technical and production expertise. The organization is designed to encourage collaboration among member organizations in areas such as program development, program sponsorship, training and resources sharing.

Oregon Ed-Net is anticipated to be self-supporting by its fourth or fifth year and is expected to function on an income provided by fees from member organizations. There is a modest annual fee for membership suggested for both public and private participants which is intended to provide a basic income. The rest of the projected income is

intended to be from hourly rates for use of its technology and fees from subscribing to various types of programming.

This model has been developed to essentially perform the same role as that being reviewed by the Montana Telecommunications Project. Organizations to be served are:

Business, small, medium and large
Government, state, county and city
Nonprofit, community and service organizations
K-12 Education, public and private
Community Colleges
Colleges and Universities (public and private)
Libraries (public, academic and specialized)

2.1.3.3 State Agency Model

In Virginia and other areas, the state is involved in the administration of the cooperative activity. In many cases the agency handling telecommunications (in Montana that would be the Telecommunications Bureau) coordinates the cooperative. Programming decisions are made through a committee structure, which, once again, reflects the membership of the organization, i.e. elementary working together, secondary together and so on.

In Oklahoma, the Legislature directed the Regents (1970) for Higher Education to: "....establish and maintain as a part of the state system of higher education a system of televised instruction designed primarily for persons living in industrial communities remote from campuses of colleges and universities and for the interchange of classes and teachers between campuses of the State's public and private colleges and universities".

The system that evolved grew out of a working relationship with business and industry for courses not readily available from local resources.

In 1985, the state received a Kellogg Foundation Grant of nearly $6 million which included a satellite capability for the state. This was to provide an augmentation to the existing terrestrial microwave system. The grant also provided resources to link existing extension offices to main campuses and to link together for continuing education purposes "Talkback TV", the OETA (Oklahoma Education Television Authority) public television network, the OSU Telecommunications Center, and the OU Health Sciences Center.

This program has evolved to include farm programming, regular college credit offerings, specialized courses in topics such as sanitation, food handling, alcohol awareness, library technical services and mail processing management.

The best known element of this system is the programming which supports the broadening of the high school curriculum and which provides language science and math programs to high schools rurally isolated and without the resources to offer a strong curriculum to students because of a lack of staff.

The NUTN (National University Teleconference Network) is also part of the system.

2.1.3.4 Consortial Model

The model most frequently found with cooperating educational institutions is consortial in nature. These models are normally framed as not-for-profit or joint power authorities which essentially function independently from the public systems.

The organizations are founded upon an identified common need and are supported through membership fees and income derived from leasing and/or selling instruction materials developed by the group to other entities either regionally or nationally. The community colleges in the country often use this model and have had considerable success with it over the past twenty years.

Fees can be based on the size of the institution/district and take a variety of forms such as charging per enrolled FTE or designing a funding formula based on the number of users. A per head user fee on top of a basic membership fee is also fairly typical when using instructional packages developed by others.

2.1.4 Resource Sharing

Regardless of the nature of governance, the Montana Telecommunications Network should function as a cooperative. It is to everyone's advantage to identify resources through some mechanism (process) which is accessible to everyone who might be able to utilize the resource. In some cases this might mean paying a fee, but regardless of that eventuality, it is to the advantage of all that this occur. Examples of resource sharing at all levels can include but not be limited to:

2.1.4.1 Human Resources
Staff with expertise in special subject matter and production skills are available within the state. Several areas of need within the state can be addressed by developing a consortial effort where staff can be utilized via telecommunications or, in a worst case, used in such a way that there is greater access to the resource information.

Production staff, writers, directors, software developers and others will be required to develop programs regardless of medium. There are many educators in Montana who can provide this kind of support. Those individuals, K-12 and those at the postsecondary level, need to be identified and made available through staff development/in-service training sessions to others in the state in order to develop a strong cadre of support and creative staff for others who are interested but have no experience in developing materials for such programming.

In fact, it would probably be to the advantage of OPI, Higher Education and others to recognize that there will be an ongoing need for such support staff.

2.1.4.2 Production Facilities
Production facilities in Montana are limited. With the exception of the major universities, most studios have minimal equipment and space for anything other than very basic production. Sharing of existing facilities, especially in the eastern portion of the state will be necessary to initiate programming needs not available from outside the state or in formats required by educational institutions within Montana.

2.1.4.3 Programming/Courseware
There are some materials/programs already being utilized within the state. Not everyone is aware of these existing resources. By sharing such programs, start-up costs for many of the smaller school districts can become a reality without impacting existing budgets. Pooling the courseware at a central location capable of statewide distribution may have some merit.

It is not without reason that one could suggest that a school district (or state agency - OPI?) consider a master file of slides or video tapes, for example, that could be transmitted, when called up by a classroom teacher, from a centrally stored collection. Such a configuration could reduce film, video and other visual materials costs considerably. Money saved from duplication could extend the size of such a collection far

beyond what most schools are now capable of purchasing. Even more fundamentally, a small rural school which could not ordinarily afford the courseware, would have it equally available as would any school throughout the state.

2.1.4.4 Staff Development
There are nine regions which represent the K-12 community in the state. Within each region there is staff with special expertise that can be shared. Such sharing can be accomplished through the use of the various on-line networks already functioning within the state or through shared staff development workshops.

2.1.4.5 Cooperative Purchasing
Cooperative purchasing of materials is another area where cost savings can be of great advantage. By sharing lists of needs in regard to purchasing (video, computer and other software) such cooperative purchasing can broaden the resident libraries of materials. If these materials are then shared through the regions and state, Montana can develop a substantive library of materials for little, if any, added cost.

A secondary benefit of Cooperative Purchasing is the elimination of redundant purchases particularly as related to courseware. The funds saved in the non-duplication of existing courseware inventory could be used to expand the library of available materials or other user defined needs.

2.1.4.6 Facilities Shared
The sharing of facilities to access programs is another approach. In many areas of the country, various educational entities share "Centers" or locations in order to access programs and/or equipment. This already occurs in Montana to a degree, but could be explored to provide even more flexibility.

2.1.5 Recommendations

With the understanding that a proposal for an affordable statewide educational network will also be a product of this study, the recommendations for this section of the report have been condensed to the following five critically important points:

1. **Initiate a program to include telecommunications related training in all teacher in-service training programs.**

2. Establish a centralized menu driven educational resource data base accessible by any model personal computer at affordable telephone line rates. This data base would serve as an electronic card catalogue of a library of all courseware applicable to that instructor. As a minimum, this "library" of information would include pre-recorded materials, satellite delivered programming schedules, Montana originated programming schedules as well as any other courseware which may be applied to Montana Education.

   The actual data base and computer system model might be that of the present Goliath system. The administrator of the data base could be the Office of Public Instruction or the State Library.

3. Centralize the purchasing of any educational related courseware or technical resources on a statewide basis; perhaps the OPI for courseware and the Telecommunications Bureau for technical resources.

4. Establish ".... the technical and operational support of educational telecommunications ..." as an additional named specific responsibility of the Telecommunications Bureau of the Department of Administration. A portion of this responsibility will be to maintain a constantly updated list of telecommunications resources available to educators inclusive of private sector networks and the more traditional local carriers. As the centralized technical resource for educational telecommunications, the Telecommunications Bureau will then provide information to educators with respect to their available options for distance education or their options for the acquisition of additional courseware.

   In addition, the Telecommunications Bureau will serve as the coordinator of any shared telecommunications resource in the state of Montana to optimize its use.

5. Provide a mechanism to distribute the centralized information gathered in the above recommendations to educators at all levels throughout the state. Inclusive in this information should be a concise method by which these educators may access this information for their individual needs.

2.2 Proposed Organizational & Administrative Structure

Section 4.1.5
Identify alternative organizational and administrative structures, with recommendations.

2.2.1 Principles of Organizational Planning

The following principles are considered in the development of an organization which is designed to "network" and still be responsive to individual needs:

1. As much as possible, the network should be transparent to the user and must meet multiple needs.
2. The network/organization should utilize the economics of shared facilities to the extent feasible.
3. The network must retain operating flexibility for changing requirements, technology, and economics. It should be alert and able to take advantage of new efficiencies, economics and increases in potential system productivity.
4. The network must include a mechanism for participation in planning, coordination and decision making.
5. Network management must provide procurement procedures that can realize the efficiencies and economics which become available in a rapidly changing technological, programmatical, economic environment.

2.2.2 Recommendation

We recommend that the state of Montana take advantage of the elements already in hand as a result of HB28 to form an Educational Telecommunications Cooperative which would function as the Board of Directors for the educational community in Montana. Although the membership of the Cooperative Board might be reconstituted later as a result of the second half of this project, it clearly can serve the needs of educational telecommunications use in Montana by functioning as a policy making body in regard to program and technical access of the network.

There are some primary issues which need to be addressed in order for any cooperative model to be implemented in Montana. Although many examples of models might be suggested, we feel only one should be considered because of the political and economic issues currently being addressed by the State of Montana.

2.2.2.1 Organizational Approach

Generic to any organizational model which evolves in Montana, is the need to include four elementary components. It is conceivable that each could function as a separate unit, but it is important to recognize that their function overlaps in many ways with the others. The three are:

1. The network should have an ongoing process of in-service training for network users.

2. There needs to be a process which identifies available programming from within the state as well as the rest of the country for interested parties wanting to use the mediums of voice, video and data, separately or together.

   Identification of production capability, making production resources available and helping to design production (scripts, talent, technical capability), all are imperative to the success of the network.

   In addition, group purchasing of instructional, educational, and student service materials through a group purchase effort will make the network effort economically feasible. If the organization does not take this step, it is our opinion that the network concept will be cost prohibitive for small schools and thus not address the "equity" issue.

3. Inherent in the cooperative should be a unit which handles the technical systems for the network. By having a single entity which has an overview of needs and which can, through volume of use or other means reduce cost, the network should be able to realize economies of scale in obtaining resources from telephone companies, satellite services providers, etc.

4. Inherent in the development of any network which will support the educational and training needs of the State of Montana, is a coordinated effort to interface with the library community. Of all the resources in the state, the libraries have the best communication between each other.

   All libraries at one level of sophistication or another are:

   *Interested or involved in on-line networking

*Have automated systems approaches

*Involved with the educational community and provide student resources

*Developing programs regarding many of the same issues as the educational community

*Able to link communities to distant institutions through the use of their facilities as community centers

*Already sharing their own resources with each other

Because libraries are such an integral part of the educational resource of the state we have identified them as a separate entity in the Cooperatives Table of Organization.

2.2.2.2 Consideration of Cooperative Issues

Attendant in the development of this kind of cooperative effort are basic questions which need to be asked of potential users:

1. Will members of the educational community really cooperate with each other in the development of such a network?

2. Are there compromises inherent in the network concept that are unacceptable?

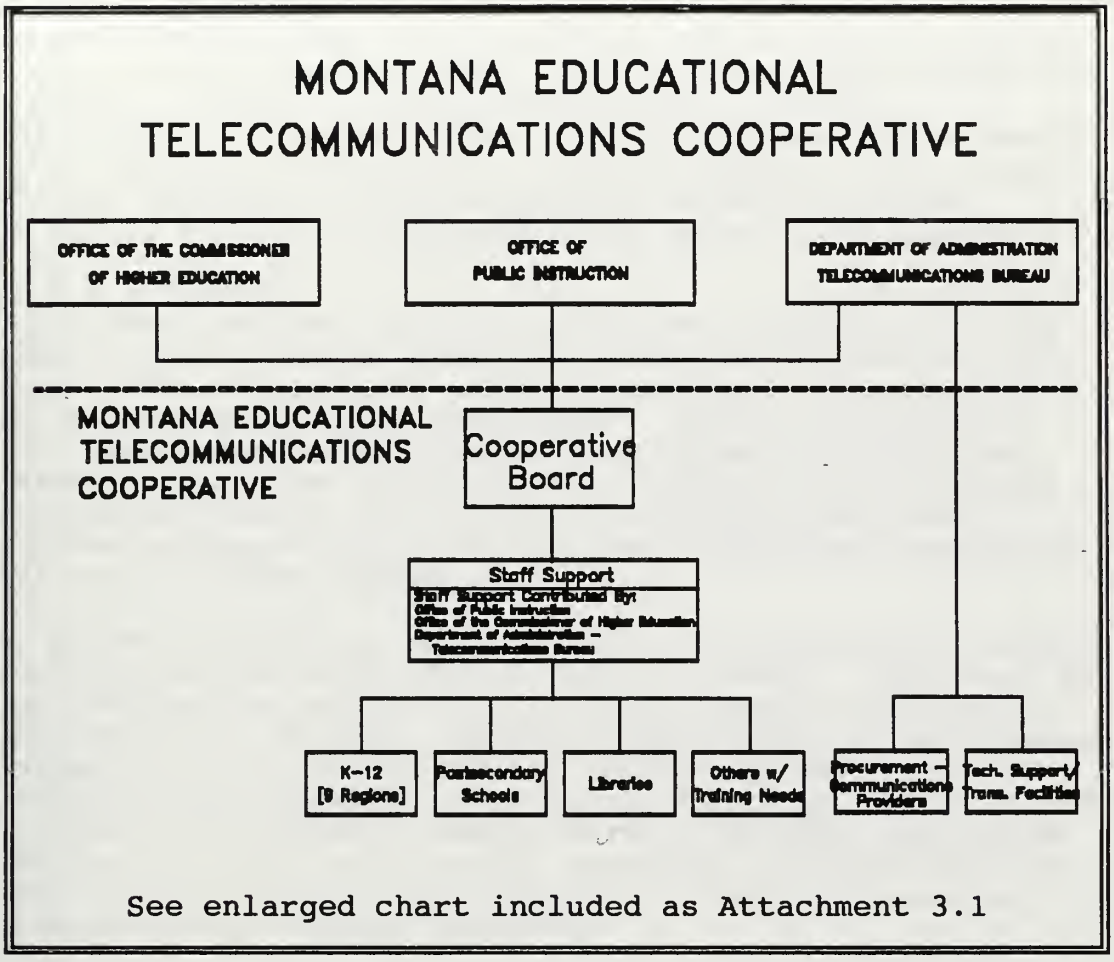
3. Will the technology options being made available best serve our needs?

4. If there are fees involved, will participants be ready to guarantee enough income to support the network?

   (The need for funds might be alleviated if there is a base of funding from the state or other resources)

2.2.2.3 Suggested Cooperative Model

The organization would be handled essentially as a department of the state but one which has its own Board of Directors who represent users. The organization would be staffed by personnel provided by the state. In this way, the state underwrites the network by providing personnel and space thus allowing the initial costs of the network to be focused solely upon technology and programming services.



See enlarged chart included as Attachment 3.1

The initial function of the Cooperative would be to provide programmatical and technical access to material already available elsewhere. It would also serve the educational needs of both public education as well as the private/non-profit community

2.2.2.4 Governance

In this model we would recommend that the Cooperative already in place be a policy advisory Board to the Office of Public Instruction, the University System and the Department of Administration in implementing & operating a distance learning network (Cooperative).

The role of the Board (Cooperative) would be to establish procedural and operational policy and to assure access and equity to the network.

2.2.2.5 Staffing
Staff in this model can come from each of the two educational offices in the state (OPI and the Higher Education Office) and from the Telecommunications Bureau. Educational expertise from OPI and from the Higher Education Office can provide the ongoing support and liaison to the network and the technology expertise can be provided by the Telecommunications group (see diagram).

2.2.2.6 Funding
The state provides initial funding and continues to support the activity by providing staff and office facilities. The cooperative would generate an income intended to offset operational costs only. Special funding for the cooperative should be pursued through legislation, bonds, grants and other options. Montana will probably take more time to become self sustaining than other states because of its size and the limitations presented by state funding options.

A variety of options are available to make funding available to the Cooperative for start-up funds. Each need to be reviewed in context with current budget, legislative potential for support, special taxation and or bond issue potential, and private sector support (through grants or training partnerships). We cannot recommend any specific solution for initial funding at this time and would prefer to work with state staff currently involved with us for the remainder of the project to identify practical and realistic funding potential.

The various entities involved in the "cooperative" join as members by paying a basic fee based on the size of the educational institution. This membership fee can be addressed by identifying the FTE size which is probably the most equitable way to address service (membership) fees. It is feasible to have a minimum fee, but, considering the size of some school districts (one room) in Montana, we would suggest that FTE might be the best solution so that all can afford to join.

Initial support for the organization could be integrated as part of developing a legislative package. The package could be presented to the legislature in order to provide initial funding to access technologies identified by the cooperative as most suited to its needs.

Income would be provided in three ways:
1. Membership fees
2. Contracting with entities for network access
3. Fees charged for services (production/workshops/in-service)

2.2.2.7 Program Library
The staff would develop a data bank of available programs for all segments of education. This material would be made available to member institutions on a regular basis with an evaluation of applicability to program needs in the state.

2.2.2.8 Technical Support/Transmission Facilities
Production/transmission capability can be processed through the Telecommunications Bureau and through the expertise provided by them. Contracts can be procured from the various communications providers working with the cooperative such as telephone companies, software programmers and video/audio producers.

2.2.2.9 Economic Development
In addition to educational programs, the cooperative might develop an interface with the private and non-profit sectors. Addressing the training needs of these groups could provide an ancillary income and provide additional support for the operational needs of the network. Care should be taken in regard to this potential relative to any conflicts of interest when using various technologies for distribution.

2.3 Montana Educational Origination Options

Section 4.1.6
Evaluate and make recommendations on telecommunications technology origination options in support of education, noting what is in place and what further investments may be needed. Address specifically the uplink accepted for installation at Montana State University.

The Lambda project team has continued to investigate telecommunications resources within Montana. Cooperation from the various elements of the telecommunications community has been outstanding. We now feel that we have a solid data base to make recommendations for origination options to support distance learning objectives.

In this section of the second interim report, we submit several origination options, the technologies they utilize, and the potential suppliers for these networks.

2.3.1 Present Origination Capability

The state of Montana is not without its own very significant origination options even today. The following capabilities are discussed with the caveat that all are possible today without an expenditure of state funds.

2.3.1.1 Through the MSU Uplink

In the first interim report we outlined a network utilizing satellite(s) and an uplink at the Montana State University, Bozeman. Since that report was written, the uplink station at Bozeman has been constructed, tested, and is ready at this time to accept traffic. We still feel that a satellite network has great merit because it gives all schools the opportunity to participate, costs are distance insensitive, and we believe it to be cost effective for larger classes.

The uplink has the capability of reaching any Ku band receive dish in the United States (including Alaska) and Canada depending upon the satellite transponder rented at the time. The schools to be served would be equipped with an appropriate satellite television receiving station, and the imbedded telephone infrastructure would provide the return path for two-way audio interaction between student and teacher. A secondary use for the uplink may be teleconferencing with educators in other states also equipped with a Ku or C band uplink. A full two-way video and audio teleconference is possible using the uplink for the "send" portion of the signal and an inexpensive downlink for the "receive" portion of the satellite transmission.

The primary disadvantages to the uplink in Bozeman are two-fold. First, the Ku band receive capabilities of the extensive installed satellite receive antennas are limited. Our current estimates are that less than one antenna in twenty installed are capable of receiving the Ku band transmissions from the MSU uplink. This problem may be solved with a $300 to $500 antenna modification together with the use of relatively high power Ku band satellite transponder such as the western regional beam of Spacenet III.

The second disadvantage of the use of Ku band is the continuing costs of the satellite transponder. Current estimates range from $360 to $600 per hour for satellite time. If these costs are to be passed on to the student base in the form of increased tuitions or fees, a relatively large number of students will necessarily need to be gathered prior to any use of the uplink for training. Professional re-certification may not be so cost sensitive, however. One possible solution may be to purchase excess Ku band satellite capacity from other educational users on Ku band at cost. This could reduce satellite time costs by 50%.

Existing downlinks have already been installed in Montana by homeowners, businesses, cable TV companies, schools and the National Rural Telecommunications Cooperative. Cable TV companies have offered to install additional downlinks at Montana schools as have the Montana independent and cooperative telephone companies.

2.3.1.2 Through Computers

Given that a personal computer is equipped with a modem, it is by definition capable of origination of a telecommunications signal on a fully interactive two-way basis. Furthermore, this mode of two-way interactive telecommunications is available today through the existing telephone systems on a statewide basis.

Schools of all levels can benefit from a network utilizing the existing telephone infrastructure in Montana. Several packages exist within Montana (EDUNET, Big Sky Telegraph, Goliath). A myriad of national data bases and bulletin boards also exists. We suggest that all schools, elementary and middle schools be included as well as high schools, colleges, and universities. "Computer literacy" can be obtained at an early age and will benefit the individual in what is now the information age.

The elements of such a network are virtually all in place. The resources are:

(a) U S West
(b) Independent and Co-op Telcos
(c) The State owned and leased facilities
(d) The AT&T "State Calling Service"

We recommend that the Telecommunications Bureau assume a goal of providing a service with a distance insensitive cost of less than $.10 per minute to any user in the state.

The telephone infrastructure is already in place. No additional capital cost to the state or school districts is required for the line segment. Our needs assessment has indicated that a high percentage of schools have computers but do not have modems for interface with telephone lines. It may be necessary to add lines to eliminate excessive queuing at the schools for access to the network.

We further recommend that the state provide funds for modems, and support procurement of PC's in areas of economic distress. Computer vendors should be solicited for assistance in this effort.

2.3.1.3 Through Microwave

The state of Montana has several significant terrestrial microwave system resources capable of providing origination capabilities in the more populated areas of the state. The MBA course from the University of Montana in Missoula is even now being conducted through a leased private microwave facility to Billings. Although on a one-way video two-way audio basis, this program clearly demonstrates the level of acceptability and success of a course conducted through this medium.

Secondly, the successful use of the microwave facility on a one-way basis at an estimated hourly cost of $350 clearly demonstrates the feasibility of the use of other technologies at comparable rates.

Additional microwave facilities exist today which could provide similar capabilities to other institutions in selected areas of the state.

2.3.1.4 Through Compressed Video

Compressed video is a method of condensing the standard video/audio presentation commonly used in a manner which ultimately results in a signal which can be transmitted less expensively due to the lowered telecommunications transmission system requirements. The more sophisticated compression techniques reconfigure the television signal as a digital 1.544 Mbps data channel ("T1") which only

occupies approximately one-third the bandwidth of a standard television channel when sent as a RF carrier. Other video compression techniques range from the quality of a black & white picture telephone with still motion pictures being sent every second to plug-in computer cards for personal computers.

The relative quality of the transmission varies directly with the cost of the device which encodes/decodes the video signal ("Codec") and the data rate at which the signal is transmitted. Higher data rates (T1) and more expensive codecs ($25,000 to $45,000) send pictures which closely approximate the quality of a video tape one might rent at the local video rental store. Recent (unverified) advances in encryption technology also suggest that similar quality may even be possible using a plug-in card in a personal computer over standard telephone lines.

The potential importance of compressed video in the educational telecommunications field is based upon the following observations:

1. Compressed video may be sent over standard telephone lines without the need for fiber upgrades.
2. Compressed video is available at data rates which are billed on a per minute basis just as standard telephone call. Higher data rates are billed monthly by the telephone company on a dedicated private line basis.
3. Compressed video (in its lower data rates) offers schools the capability to communicate on a statewide basis today.
4. Compressed video can be sent over any telecommunications medium including telephone wires, fiber, microwave or satellite at a fraction of the continuing leased line costs of a full motion video channel.
5. Compressed video hardware costs are decreasing annually with telecommunications costs for digital service from the telephone companies also projected to hold even or decrease with time.
6. If any network in Montana is to succeed in the long term, it can only be with the issue of continuing "affordability" as a key issue; monthly leased telecommunications costs are the issue.

An immediate application for compressed video relates to the MBA course now being conducted in Billings. Several employees of Montana Power (Intermountain Digital) currently drive from Colestrip to Billings for the course at substantial expense and inconvenience. Montana Power/Intermountain Digital currently operates a fully two-way digital microwave link between their facility in Colestrip and Missoula with excess T1 digital channel capacity. Dave Wilson in Missoula currently is testing two T1 compressed video codecs in Missoula. If Montana Power/Intermountain Digital were to install a digital microwave link to the Missoula campus, the University of Montana could conduct their MBA program simultaneously in two locations, Billings and Colestrip. The Colestrip class would be fully interactive two-way video/audio/data using T1 compressed video while the Billings class would be one-way video with two-way audio over the leased microwave.

Similar excess digital microwave capacities exist on other private networks throughout the state at hourly rates which are only a fraction of the costs of full motion video channels.

2.3.1.5 Through Fiber

We are advised that several schools in the areas operated by the independent and cooperative telephone companies have fiber installed. This access to the telecommunications system of the future gives these select schools the ability to communicate on a fully interactive full motion video basis today. By regionalizing these clusters of interactive fiber systems to schools and interconnecting a central office in each of these regions, a statewide interactive video network through fiber can be accomplished. Similar networks are being constructed elsewhere with some success.

The video for these networks is being transmitted as digital 45 Mbps channel (DS3) or as a group of analog channels on a dedicated fiber pair. By way of comparison, twenty-eight T1 compressed video channels can be sent in the same bandwidth or data channel as the one full motion channel.

On a national basis, rates for the service as charged by the telephone company seem to be approximately $2,000 per month per school depending upon the amount of construction necessary to provide the service to each school. The Lambda project team has conducted interviews with many of the telephone companies in Montana and have found a sincere desire to make such a service "affordable" to

all schools within their respective service areas. It is the definition of "affordable" which seems to be the differentiating factor between the various service providers.

At least two of the telephone companies have discussed rates with the project team which in our opinion are two of the best telecommunications buys of the century if carried through to a contract. The rates discussed would be guaranteed for a period of ten (10) years for the schools. The capabilities would include fully interactive broadcast quality video on a truly regional basis. The two telephone companies are the Mid Rivers and Blackfoot cooperatives.

2.3.1.6 Through Broadcast Television

The PBS station operating from the MSU campus, KUSM, has agreed to dedicate six (6) hours of its broadcast day from 9:00 AM to 3:00 PM for the purpose of instructional training. This immediate origination capability will provide one-way video two-way audio instructional training anywhere in the KUSM service area today. The KUSM service area includes TCI cable television systems which currently receive the KUSM signal via a TCI/WTCI private microwave system. Unlike other forms of telecommunications discussed earlier, this mode of delivery of instructional training is available in the homes of the end users.

2.3.1.7 Through RTS Stations

The continuing proliferation of rural low power television stations represents a cost effective opportunity to accomplish the "last mile" delivery of educational programming to an end user. The project team has investigated the Montana RTS systems and have concluded that they are technologically without equal in the enterprise of the delivery of television programming in rural Montana communities. They offer the combined ability of importation of distant television signals through satellite reception to local insertion and program origination.

If considered in conjunction with other statewide satellite origination potential, the RTS systems in selected areas of rural Montana have the capability of delivery of live broadcasts originating in Montana to otherwise technologically isolated communities. (This assumption is based in part upon the continued evolution of the present RTS site capability to additional remote controlled programmable steerable C/Ku TVRO antennas.) Educational satellite broadcasts originating in any part of the state

or from any school connected by fiber to any uplink, could be received and retransmitted over an RTS site throughout the most isolated or rural Montana communities.

Local RTS origination capability presently includes any form of audio, video or data in its coverage area. Selected local sites are equipped with equipment which allows the direct programming (origination) of the local RTS television transmitter.

2.3.2 Further Investments

As stated previously, the state of Montana has substantial origination capability already in place. Modest investments are recommended which will even further optimize the existing resources afforded by these origination capabilities. This portion of the report is intended to state potential uses for additional investments in the already existing network and does not begin to address the potential sources for the funds.

2.3.2.1 Additional C band Uplink

In the first interim report we outlined a network utilizing satellite(s). Since that report was written, the uplink station at Bozeman has been constructed, tested, and is ready at this time to accept traffic. We still feel that a satellite network has great merit because it gives all schools the opportunity to participate, costs are distance insensitive, and we believe it to be cost effective. We have further evaluated this option, and tentatively recommend the following:

A. Construct a C Band Uplink

Potential site locations could include but are not limited to; Helena, Missoula, Kalispell, Bozeman, Billings, Miles City or Glendive. Final site selection for the uplink should be based in part upon the following factors:

1. The location should be a source for courseware of general statewide interest at all levels;
2. The location should be electronically accessible by the maximum number of origination sites including K-12 schools, tribal colleges, community colleges and four year institutions (if possible). One example may be participation in a regional network.
3. Personnel resources of the location should include sufficient technical and operational personnel to ensure the long term technical operations of the uplink.

Although consideration for a mobile C-Band uplink had been given, the project team recommends limiting mobile uplink operations to Ku Band due to both size and cost limitations. A fixed C-Band uplink, however, could be quite affordable.

We estimate that an adequate station including construction, engineering, and licensing costs can be put in place for under $200,000. We recommend that industry and/or private funds be solicited for this purpose. We are currently obtaining quotes for an earth station and will soon be able to provide a detailed cost estimate. In general, C Band satellite costs are less than Ku Band costs.

B. A training program be instituted for technical personnel in the operation and maintenance of all ground equipment (uplink and downlink).

2.3.2.2 Additional Downlinks

Educators have stated the desire to access certain informational and instructional courseware only available by satellite. The MSU uplink and potential U of M uplink even further provides statewide justification for enhancement of the satellite transmission telecommunications capability of the state. It is, therefore, recommended that every school in the state be equipped with a C/Ku band satellite downlink. Sources for this equipment include the generous offer of TCI cable and the discounted prices even now offered by the independent and cooperative telephone companies through their alliance with the National Rural Telecommunications Cooperative.

Many schools which already have antennas installed will only require a conversion of the feed assembly to become Ku band capable; still others may require an additional satellite receiver.

2.3.2.3 Additional Modems

Many schools have computers installed without modems to communicate with the statewide computer resources. For these schools, it would seem appropriate to provide modems and training in the prudent use of the new telecommunications resources afforded by them.

2.3.2.4 New Regional Networks - Fiber Optic

Our needs assessment study has uncovered a desire on the part of the educational community for regional sharing of instructional resources. Discussions with some telephone companies has produced positive response to this desire. In this section of the report we will outline the current

plans of two co-op telephone companies who can provide a wideband transmission facility to interconnect several high schools in or near their service areas.

A. Mid Rivers Telephone Company

The plan of this company is currently being implemented. In this plan, two sections containing four communities each would be interconnected for two-way video and audio. A wideband fiber optic cable would be used as the transmission medium. The form of modulation would be digital with DS3 codecs and support electronics at each location.

The southern cluster would include terminals at: 1) Ekalaka, 2) Plevna, 3) Baker, and 4) Terry. Miles City (presumably, Miles Community College) would be included to provide enhanced programs and guidance. The northern cluster would include the communities of: 1) Circle, 2) Richie, 3) Lambert, and 4) Glendive. A connection from Glendive to Terry would exist to provide interchange between the clusters.

B. Blackfoot Telephone Company

Blackfoot is currently working toward a cooperative arrangement with US West to establish a regional network similar to the above described network with a tie to the resources of University of Montana, Missoula.

There is an indication that the costs involved in these regional networks will be reasonable and affordable. If this be the case, we recommend that the state endorse this option when details are provided. We stand ready to assist in evaluating proposals, and recommend that the state government encourage other regional network providers to present proposals.

2.3.2.5 Compressed Video Network - Terrestrial

Compressed video is an origination technology worthy of consideration in the Montana Educational Telecommunications Project. It is a dynamic field with rapid advancements and decreasing costs. A further discussion is given in section 2.4.6 below. It is not at all clear from our work so far that a compressed video network is viable for a broad-based educational context in Montana. It could be viable for use between most major colleges and universities in a short time frame of from one to two years. However the cost of codecs and line charges currently appear to rule out a <u>state-wide</u> use of this technology for K-12 for now. The factors which form this judgement are:

A. Terminal (customer premise) equipment

Costs of codecs and room rearrangements costs are high. See paragraph 2.4.6 below.

B. Local loop requirements

Virtually all local loops (from school to central office) cannot support the data rates required for acceptable video quality for instructional purposes. Construction costs vary widely, but the average seems very high, and generally out of the reach of most schools.

C. Central office switching

D. Interoffice lines

There are many positive factors uncovered in our study of existing facilities which mitigate towards use of compressed video.

(a) One vendor (Intermountain Digital Network) with points of presence at nine locations has indicated unequivocally that they will provide rates on a time usage basis. They have provided the team with sample rates which are judged to be reasonable. No other carrier has indicated a willingness to supply wideband rates on other than a dedicated (full time) basis. U.S. West has indicated that they would make a decision in this regard late in 1991. The independent telephone association has indicated that each company within its membership would make this decision separately.

(b) Apparent breakthrough - DS0

A recent and very impressive demonstration of a DS0 computer based system has suggested that acceptable interactive video quality may be possible at 56 kbps data rates. If such a system is "genuine", regionalized interactive computer based video networks will be possible throughout Montana at very affordable rates.

2.3.2.6 Enhanced State Telephone System

The Telecommunications Bureau already operates a sophisticated statewide telephone system which allows state government offices to place long distance inter-LATA calls at affordable rates. Given that public schools are also eligible for participation in the state telephone system, it is recommended that the Telecommunications Bureau provide the public schools access to state network. Preliminary discussions with the state engineers

suggests that a capital expenditure of approximately $100 thousand will be required to upgrade the capacity based upon speculated usage rates.

2.3.2.7 Studio/Classroom Equipment
Although several schools have succeeded in equipping studios and classrooms for the video age, the majority of the Montana schools will require additional equipment in order to make full use of any video based network. As a minimum, television monitors and video tape recorders will be required where video services are accessed. Cameras and elementary switching equipment will be required for the more sophisticated participants in any network.

2.3.2.8 Training
Training cost with respect to the use of a video based telecommunications system must be an integral element of any proposed network. The training may take the form of additional instruction provided during any already recurring teacher in-service training being provided.

2.4 End User Equipment Requirements

Section 4.1.7
Identify minimal required receive site configurations and desired receive site configurations, with estimated costs, for equipping school buildings and classrooms (or libraries or other public buildings) to accommodate recommended educational telecommunications.

End user equipment requirements depend upon the service to which an end user decides to subscribe to, or the particular technology used in the recommended networks. Both satellite and terrestrial networks are recommended with differing bandwidth requirements. A school or other institution as a user may wish to participate in more than one network service. This section of the second interim report, provides equipment configuration and costs for each service.

It is further assumed that a "minimal" receive site is one in which the least possible capital dollars are required to provide access to the network; or, an interactive computer based service.

2.4.1 Minimal Receive Site Configuration (Computer Interactive Service)

Most computer-aided-instructional (CAI) services utilize voice grade analog transmission medium capable of 1200 bits/second data rates. This is accomplished with plain old telephone service (POTS). In most locations in Montana digital facilities exist between central offices and in some cases in the local loop. Conditioned lines capable of handling higher data rates can be obtained from the local carrier. The advantages of higher data rates are faster interaction and better graphic presentations. The disadvantages are in higher costs of computer peripherals and modems (interface between line and computer), as well as higher line costs.

2.4.1.1 Minimum Equipment Configuration for Computer Interactive Service

Personal Computer, 1200 baud modem, with black and white monitor, Dot Matrix printer (Software-variable cost from service providers)	$1,000 - $3,000

This minimal configuration is capable of providing one student (at a time) access to many available national and Montana originated information data bases, bulletin boards, and credit courses. Notable current Montana based CAI services are; EDUNET, Big Sky Telegraph, and Goliath.

2.4.1.2 Desirable Equipment Configuration for Computer Interactive Service

For large institutions such as universities, colleges and large high schools where a large number of students are to be served simultaneously, the following additional items may be desirable:

Main frame computer, work stations, integration software, color monitors, laser printers, "Smart" modems, Broadband Local Area Networks or Ethernets.

Cost figures are not included here because of the wide variation in quality and capability available. Each case should make an analysis of needs and budgetary limitations.

2.4.2 Desired Receive Site Configuration (For Satellite Delivered One-Way Video Service)

One-way video instructional service is usually delivered in full (4.2 MHz baseband) NTSC color video format. Some private networks utilize a MAC (multiplexed analog component) format. Some are transmitted from the satellite at C Band (3.7 to 4.2 GHz) and some are transmitted at Ku Band (11.7 to 12.2 GHz). Some are scrambled for limited access because of copyright. Some utilize a full satellite channel (transponder) and others share a channel (1/2 transponder operation).

The satellite receiving system recommended for use in the Montana schools is capable of receiving virtually all C Band and Ku Band transmissions. Full transponder C Band, and either full or half transponder Ku Band services can be accommodated. It can accommodate NTSC color format, but not MAC format. It can obtain authorization if the signal is scrambled using "Videocipher II Plus" technique.

2.4.2.1 Minimum Equipment Configuration for One-Way Satellite Delivered Service.

Complete earth station estimate	$1,500 - $2,000
TV set or video and audio monitor (each)/ Video cassette recorder (VCR) estimate	$500 - $1,000

For schools that have either C Band or Ku Band receiving systems and wish to upgrade their existing systems, they should contact their original vendors for cost. It may be cost effective to include the recommended package rather than modify the existing configuration.

2.4.2.2 Desirable Equipment Configuration for One-Way Satellite Delivered Service

In large institutions, simultaneous reception of more than one program from more than one satellite may be

desirable. Furthermore, it may be desirable to distribute the program(s) to more than one room in a building or to other buildings on a campus.

To receive more than one satellite simultaneously, separate dishes are required for each satellite. To receive more than one program from a satellite simultaneously, separate receivers are required for each program. If the programs are on different polarizations, the antenna configuration must accommodate both polarizations. For multiple program distribution, the distribution system may have to be channelized or multiple cables must be used. Since there is a large number of options, each case should be analyzed as to needs and budgetary limitations.

2.4.3 For Terrestrial Delivery of One-Way NTSC Video and Audio

Information services can be delivered by terrestrial means in a variety of ways.

(a) Over-the-air, Vestigal Sideband AM (VSB) (VHF, UHF or Microwave ITFS)

(b) Coaxial cable, Vestigal Sideband AM (VSB)

(c) Fiber optic, VSB, or FM

(d) Fiber optic, digital

For over-the-air VHF and UHF or coaxial cable delivery, all that is required is a television set that is compatible with the cable and over-the-air frequencies and an appropriate coaxial distribution system. Cable systems offer A/B switches for selection.

For microwave, ITFS, an appropriate antenna, and converter are required	$225 - $275
For fiber optic systems using analog VSB, a lightwave demodulator is required.	$2,000 - $3,000
For fiber optic systems using analog FM, an FM demodulator is required in addition to the lightwave demodulator.	$2,000 - $5,000
The output of this FM demodulator can be fed to video and audio monitors. If distribution to TV sets at VHF or UHF is required, a vestigal sideband modulator is required	$1,000 - $3,000

For fiber optic systems using digital modulation, a lightwave demodulator as indicated above is required, as well as a digital video decoder.

Digital decoder (one-way, 45MB/sec)	$8,000
Digital decoder (one-way, 384 kB/S to 1.544 MB/S)	$25,000

2.4.4 For Satellite Delivery of Full Bandwidth One-Way Video and Two-Way Audio.

In this mode of operation, interaction between student and teacher is accomplished utilizing telephone lines in the path from student to teacher, and the TV associated audio from teacher to student.

The equipment required is exactly the same as in 2.4.2 above with the addition of telephone line attachments (instrument and/or microphone(s)). It can take the form of a simple dial-up telephone instrument to an elaborate arrangement of directional microphones.

In an educational context with underactivity, consideration should be given to the classroom physical characteristics. It may be desirable to modify the acoustics and seating arrangements to enhance the learning experience. Each case should be analyzed as to need and budgetary limitations.

2.4.5 For Terrestrial Delivery of Full Bandwidth One-Way Video and Two-Way Audio

This class of service requires an equipment configuration described in 2.4.3 above. The discussion about audio from student to teacher in 2.4.3 above also applies.

It may be practical to utilize the return path inherently available in the coaxial or fiber facility. In cases where coax or fiber lines can accommodate this return audio, adding voice grade transmit equipment at the user location may be cost effective if the line charges for the coax or fiber is significantly less than the telephone line charges.

2.4.6 For Digital (Compressed) Two-Way Video and Two-Way Audio

In many instances, especially in post secondary, and in high schools on a regional basis, two-way video and audio may prove to be both desirable and affordable. In planning such networks, the user must weigh line charges over a period of time against cost of user terminal equipment (codecs). Line charges increase with higher data rates, and codec costs

decrease with higher data rates. Quality of picture (ability to reproduce motion free of artifacts) improves with higher data rates.

The technology of compressed video is rapidly changing due to a number of related technology advances. Storage technology, prediction algorithms, and microprocessor speed along with cost breakthroughs in VLSI technology are coming together to produce codecs that perform better at lower data rates, with price reductions even in small quantity production.

In an educational context, generally acceptable quality is obtained with 384 kB/S (1/4 DSI line) or 768 kB/S (1/2 DSI line) with production equipment. "Broadcast quality" is obtained at 45 MB/S (DS3 line) with production equipment. The Lambda Team is investigating what <u>appears</u> to be a breakthrough in technology where acceptable education quality can be obtained at a 56 kB/S (DSO line rate). A DSO line rate is a "standard" telephone voice channel rate.

Compressed video can be transmitted by <u>any</u> digital transmission medium, terrestrial or satellite. In the Montana context, satellite transmission may not be a viable option since in addition to codecs, a fairly expensive earth station ($40,000 to $50,000 including codec) is required, and occasional use satellite time for the carriers is rare and expensive. However, terrestrial connection in Montana may prove to be affordable through the facilities of the various local, and regional carriers.

2.4.6.1 Codec Costs:

(a) DS3 "Broadcast Quality" ----------$35,000 each

(b) DS3 Entertainment Quality ---------- 10,000 each

(c) Variable Rate 1/4 DSI to DS1 ---------- 35,000 each

(d) Variable Rate DSO to 1/4 DS1 ---------- 25,000 each

These prices are approximate, and represent current production unit prices. As indicated above, performance and price changes are occurring rapidly in this market. In six (6) months to one year from now (April 1990) the situation could change drastically.

2.4.6.2 Camera, Monitor and Controls

Vendors of compressed video codecs, also provide an electronic package of monitor(s), camera and controls. This package is generally lower in cost than if the user were to purchase equivalent equipment separately. No attempt is made here to provide a minimal or desired configuration.

2.4.6.3 Physical Facilities

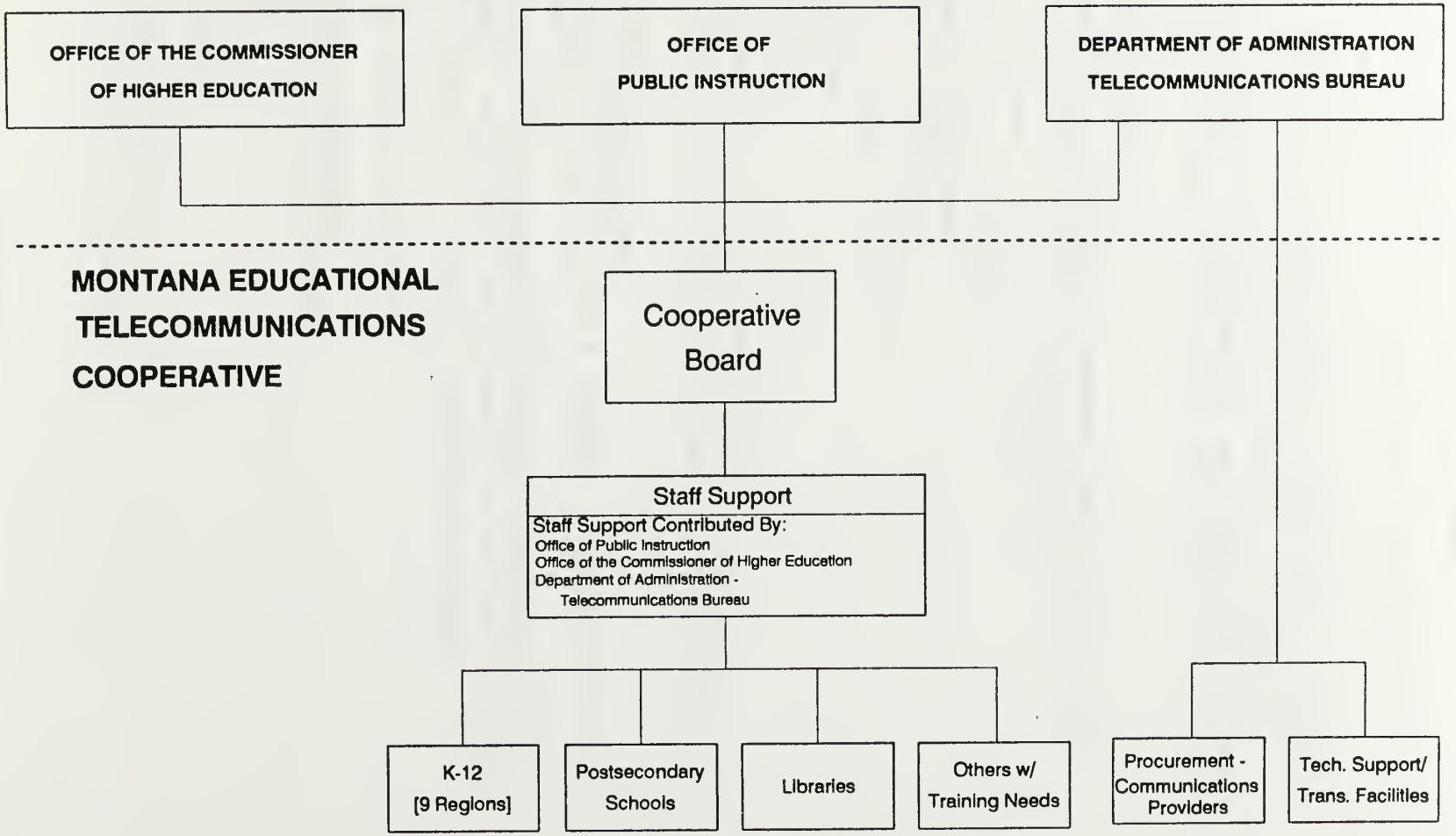
For a two-way video interactive system it will probably be necessary to modify a classroom not only with regard to acoustics and seating arrangements, but other factors such as lighting and camera placement must be considered. No estimate of these construction costs are included here since they will vary greatly with the institution or school district involved.

SECTION 3 - NEEDS ASSESSMENT

3.1 Proposed Organizational Chart

MONTANA EDUCATIONAL

TELECOMMUNICATIONS COOPERATIVE



3.2 Programmatical Needs Identified By Assessment

3.2.1 K-12 Needs Identified

The following were typical of identified programmatical needs by K-12 personnel:

* Need programs - full classes, but, as important, support materials to broaden the curriculum in areas where low budgets and lack of personnel prevent breadth of offerings;

* In-service training for instructors and other staff unable to get to typical summer offerings at universities and colleges;

* Student record keeping;

* Software enabling networking between professional staff and others throughout the state and nation;

* Programs for those in special programs, i.e.

  emotionally disturbed
  visually impaired
  hearing impaired

* Courseware in special topics, i.e.

  languages
  math
  science

* Increased access to library resources;

* Support from OPI staff with specialized training/knowledge;

* Remedial reading programs;

* Advanced placement and 2 plus 2 classes articulated with higher education;

* Programs especially designed for Native Americans or to make the general population more sensitive to their culture;

* Develop materials for a Mastery Learning Program;

* Programs of special interest:

  Big Sky Telegraph
  AT&T Educational Network
  EDUNET
  Goliath
  "Tie-In"
  Kid-Mail
  3-2-1 Contact
  Project Discovery
  PBS television programs

Reading Rainbow
Kids Network
NASA Technology Link
Audio Visual support materials to be shared

3.2.2 Middle School Needs Identified

Programs identified:

* Advanced Placement courses
* Courses and materials to broaden the curriculum
* Foreign Language classes
* PBS Programming
* Audio Visual support
* Special programs via satellite video-conferencing
* Programs of special interest:

  TCI programs in their educational package
  PBS programs and classes
  MECC - data
  Big Sky Telegraph

3.2.3 High School Needs Identified

Programs identified by High School personnel:

* Special courses offered by universities for staff
* Classes to broaden the curriculum of smaller schools
* Composition Labs
* Library support programs
* Counseling/Career Education programs
* Programs of special interest:

  EDUNET
  TCI Exchange
  Compuserve
  Agri-Net
  Goliath
  Big Sky Telegraph

3.2.4 College/University/Voc Tech/Tribal Needs Identified

Programs identified by personnel:

* Library access/on-line programs
* Graduate level programs in Ecology and the Environment
* Graduate level courses in educational computing

* Resource sharing
* Networking staff with special skills/knowledge
* Increasing Audio/Visual support
* Career Counseling
* Create Counseling programs
* Programs of special interest:
* PBS Programs
* Pre-recorded college level programs, i.e.

  Annenberg
  Miami-Dade
  So. California
  Texas
  Coast Telecourses
  Oklahoma

* Tie-In
* Community College Satellite Network
* NTU courses
* MSU Net
* Courses in telecommunications

3.2.5 Organizational Structure Comments

Comments regarding organizational structure can be condensed to the following:

* There needs to be a statewide approach when thinking about a network;
* There isn't enough information available in regard to how technology can be used;
* How would we be able to pay for program??
* The network should facilitate certain state level activities such as meetings of instructional staff w/OPI;
* The network should provide equity for smaller schools;
* The network should be organized in such a way that there is good coordination between segments with certain programs;
* The network should be able to facilitate action and shorten bureaucratic barriers.

3.2.6 Reported System's Needs & Futures List

The following are typical of desired components for an educational network:

* Network fees should be as inexpensive as possible so schools can use it effectively;

* The system should have some element of voice/video/data in order to have multiple use simultaneously;

* Ultimately, some would like two-way video live for live interactive programming. This is not seen as an immediate need by most respondents;

* The network should improve access from one segment to the other, i.e. Advanced Placement and 2 + 2 programs.

3.3 Other Cooperative Programming Issues

The use of computers in schools is growing at an amazing rate. It is estimated nationally that the purchased number of microcomputers in the kindergarten through grade twelve market has now surpassed 1.6 million machines and will double in the next four years. The machines are also being used increasingly in new ways. This is due mainly to the development of "peripherals". These resources provide a whole new world of source materials and creatively expand what can occur in the classroom. One of the uses as related to the use of microcomputers in the classroom is to use data banks now commercially available. In this process a classroom computer can be used to search through database information services and retrieve topical information instantaneously. For example, a number of major news sources are available on databases. Students in a variety of subject matter areas such as journalism, English, or social studies classes could examine how different reporters covered the same news event. Science and other areas would also have an expanded view of their field based upon this capability.

A new resource of information and accumulated knowledge resides in the databases that have been put together in this country. Among those most commonly used are:

Readers Guide
Wire Services (UPI, Associated Press, etc.)
Compuserve
Dialog
Montana systems in place:

- Big Sky Telegraph
- EDUNET
- MSU's Science & Math Resource Group
- State of Montana's Bulletin Board (Goliath)

It should be noted that although this resource is now readily available to classrooms, the costs that can accrue through per minute use could prove to be monumental. As such, careful planning for the use of technology is very important both for the short and long term.

Nationally, it is estimated that school spending must rise to $28.2 billion by 1991-1992 to maintain the existing per pupil funding levels. These increases do not include funding for major initiatives such as teacher professionalization and reduction in class size.

The nature of developments within new and emerging technology is one area which might reduce some of the growing pressures on schools to provide better and more flexible services with less money.

Integration of systems design has become a major consideration in such planning. The introduction of the "chip" into technology has allowed educators to consider the implementation of support systems that could not have been considered just a few years ago.

Because applications of voice, video and data are now transparent (although not always cost effective), school districts looking at new voice and computer systems need to determine options and apply them to both the short and long term when planning.

Audio and video teleconferencing between a district office and school site is now a viable option for school districts covering large geographic regions.

Videotex is being used more and more by institutions as a resource to distribute data, graphics and other materials. Its greatest asset is that users need not have computer skills to access computer-type data on site. It is also interactive and therefore is not a passive resource.

Slow-Scan television is another option to be explored. Using telephone lines, this technology can send graphics to distant locations at the rate of one picture per second currently, with every indication that the technology will improve. This medium certainly has potential when looking at the array of interface needs between schools in a multiple facility district.

As a result of the availability of technologies such as those listed above, it is very important for those planning for telecommunications use to project a system that is flexible, modularized, and that can grow as growth is indicated. It is very important not to be locked into either a voice or data system that cannot, for example, accommodate the technologies listed above as need might indicate their coming on line. Infrastructure planning incorporating technology options is essential. That is not to say that all should be used, but certainly switches, main-frames and mini's should have the capability to grow and/or interface to accommodate such growth when desired.

Society is trying to grasp the implication of new and emerging technologies and their impact on institutions, business and society as a whole. Futurists and practitioners concerned with the emerging social issues of the nineties express the need for careful planning and the utilization of the resources that are available which will provide us with a better and more productive way of life.

To that end, it is imperative that the K-12 and Post-secondary educational segments also address the use of technological resources available when forging new directions for educational institutions.

When one researches new and emerging technologies and their use by both the private and public sectors, it is apparent that, for the most part, these new resources are still not as integrated into the budget planning process as one might expect; nor are they being integrated into the long term planning process.

In the educational environment, coordination and cooperation generally occur at a campus/regional level or among groups of geographically related organizations. Creation and enlargement of ITV systems appears to be prompted more by organizational self-interest and less as a consequence of any overarching public policy framework.

New and emerging technologies (e.g. relatively low cost compression equipment) will add even another dimension to an already complex and confusing maze of systems and networks.

One potential forum for discussion of collaboration and coordination relating to communication technologies is the Telecommunications Cooperative recently formed through HB28. The educational segments in Montana have put the issues of shared resources, joint design, networking and cost effectiveness on their agenda as a result of the current project reviewing telecommunications potential for their use. The magnitude of the money spent by education on data and voice (telephone) alone, might indicate a need for K-12, Community Colleges, Technical Centers, Universities and Tribal Colleges to discuss available options.

The State Office of Public Instruction has no integrated planning on the part of decision makers within the system to consider the use of data, video and other technologies when budgets are being developed. In addition, use of staff with expertise in telecommunications has been largely overlooked at the policy level prior to this year.

Like K-12, Higher Education in the state doesn't have staff at the policy development level or a plan to accomplish the necessary work in uses of Educational Technology.

Private colleges and universities have the same needs as the public institutions and appear to have the same level (or lack of) planning.

Faced with similar kinds of crises, business and education are making more and more overtures to each other seeking solutions to problems created by the "Information Age". The American Council On Education reports that:

* About 75 percent of all U.S. colleges and universities report some ties to corporations, most often through participation on advisory panels or meetings;

* It is estimated that two-thirds of all colleges and universities have some agreements with corporations for donated or loaned equipment;

* Almost half of the higher education institutions offer some kind of credit or non-credit class in a business setting.

With a reduced level of financial support clearly indicated for the near future, the impact of new techniques in supporting the educational process are clearly needed. Industry and business have legitimate concerns over the base of information and the liberal arts knowledge made available to students in our K-12 schools. The tremendous input of new persons in the workforce with deficient language skills speaks to the almost epidemic proportions of our need to provide resources to those now entering our country and their impact in a business setting. The fact that a worker in emergency situations might not be able to communicate in English should cause us to heed the warnings now heard throughout the country.

Without the assistance that can come from the utilization of new and emerging technology when addressing these and other pressing issues, our society could be in serious trouble in just a few years.

This report would not be complete without mentioning several of the resources that we have encountered while touring the state and meeting with members of the educational community.

For example, while isolated from the larger communities in the West, we found the Eastern part of the state very active and interested in the development of the services that might be provided through an educational network. Indeed, there is a wealth of human resource available within the state's instructional work force. They need, however, to be brought together and allowed to share and learn from one another.

Television production facilities in the state are limited in number (mentioned in other areas of this report) and thus are a valuable commodity. It will be important to identify and quantify those that do exist and whether they are able and interested in supporting the network by helping to support original production for their region and the state.

Mid-Rivers, Blackfoot and Nemont are but a few of the independent telephone cooperatives who have expressed a willingness to help in the development of the network by working at the reduction of rates and other economies to enable institutions

to interface through their systems. Important to this issue will be the willingness of the telephone industry (including U S West) to actually provide linkages and reduce rates.

There is a great need to support the use of computers in the schools, for example, and with the present telephone line costs, utilization of on-line networks and other digital applications are not feasible due to limited school budgets.

It will be important for the schools and the communications industry to reach long term agreements in regard to the cost of voice, video and data transmission through fiber and T-1 technology. Nothing would be worse for the educational community than to find it had committed to a network system only to have it priced beyond reach two or three years into operation.

The willingness of the communications industry to support the network concept is being expressed in virtually all meetings we have had with them.

There are a few instructional activities in the state using video that should also be mentioned. The MBA program from the University of Montana in Missoula to Billings via microwave should be broadened and emulated by others, especially in regard to distribution of staff development programs for instructional staff. The College of Great Falls is another institution which has instructional television experience. The college enrolls 200-300 students per semester using television and uses the one-way video cassette and two-way audio format. Salish-Kootenai uses their Low Power TRS capability to transmit to students and community.

A few years ago Miles Community College, through a grant, established a pilot program which provided a staff development program for faculty and which utilized the two-way live format. Although the college is not broadcasting or using this methodology at the present time, it is possible that a demonstration of this technique (two-way live) will be available in the near future.

While new capabilities can become available, we would caution educators to remember the importance of developing solid planning prior to committing to any system.

An example might be use of two-way interactive technology. In a model that links two classrooms incurred cost for each class involves:

* 2 classrooms and the cost to heat and cool the rooms;

* An instructor and a proctor or other staff at the other end;

* The cost of video/audio and other telecommunications equipment;

* The cost of transmission; and

* The cost of distributing instructional materials to a distant site.

Presuming that each class is of normal size, costs per FTE will be greater than for a normal class! As more classrooms are added to such a system, more costs accrue. This is not to say we do not endorse this instructional concept, but it is important that educators "price" systems on an FTE basis to make certain they can afford the technology.

Implicit in the use of technology is a thorough analysis of cost before getting started so that appropriate budget can be developed.

In Montana there seems to be a growing awareness that these issues must be addressed. Not only is this evidenced in our meetings with educators, but we have found an equal if not greater interest on behalf of those in the private and non-profit sector. The top priority, as one might suspect, is the support of training needs and, subsequently, the improvement of economic development throughout the state.

SECTION 4 - ATTACHMENTS (AVAILABLE UPON REQUEST)

ACCO INTERNATIONAL INC.
CHICAGO, ILLINOIS 60611